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(54) **A multiple access protocol**

Vielfachzugriffsprotokoll

Protocole d'accès multiples

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- **IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY. vol. 38, no. 2, May 1989, NEW YORK US pages 50 - 54; MURASE ET AL.: 'Idle-Signal Casting Multiple Access with Data Slot Reservation (ICMA-DR) for Packet Radio Communications'**
- **PATENT ABSTRACTS OF JAPAN vol. 9, no. 318 (E-366)13 December 1985 & JP-A-60 152 144**
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Description

Background of the Invention

Many multiple access schemes have been devised to allow a group of terminals to communicate with a central station using a shared channel. One of these schemes, called random multiple access, relies on randomly transmitted messages from a group of terminals to a central station without perfect coordination between terminals. For example, in a cellular radio environment, each cell is served by a base station communicating with multiple mobile stations. Each cell has the use of a set of radio frequency channels. At least one channel is dedicated for the purpose of setting up radio phone calls in each cell. This "setup" channel is shared by all the mobile stations to communicate with the base station. The setup channel is a full duplex channel with separate frequencies in the forward (base to mobile) and reverse (mobile to base) directions. The forward setup channel is used by the base station to transmit messages to all the mobiles. This channel is a broadcast channel in which all the mobile stations can receive all the messages transmitted from the base station. The reverse channel is a random contention multiple access channel, in which mobile stations may transmit messages to the base station with relatively little coordination. The access is random in the sense that mobile stations are not assigned a fixed transmission schedule. The access is based on contention in which mobile stations with messages to transmit will try to seize channel openings as they appear. If multiple mobile stations decide to transmit at the same time, the messages may collide and mutually destroy each other. There is also a possibility that one of the messages is received with significantly higher power than the others and is correctly received at the base station. In any case the mobile stations whose transmissions are not successful have to retransmit after some random delay.

Description of the Prior Art

Existing multiple access protocols of this sort include the ALOHA, CSMA, CSMA-CD access protocols, among others. Because of the random transmission nature and inevitable collisions that may occur, no random access protocols can reach 100% throughput efficiency. The random delay after a collision also introduces additional messaging delay between a terminal and a central station.

In the North American analog cellular system the base station and mobile stations transmit on separate frequencies to form a full duplex channel. The base station broadcasts the status of the multiple access setup channel to all the mobiles communicating with the base periodically. A busy/idle bit inserted every 11 bits in the base to mobile transmission indicates if the mobile station (terminal) to base station multiple access channel was busy or idle in the last period. Such timely feedback enables a mobile station to make sure the channel is idle before transmitting again. A mobile station continues to monitor the busy/idle bit during transmission. If the busy/idle bit does not change from indicating idle to indicating busy within a short window at the beginning of a message transmission, the transmitting mobile station assumes a collision and the transmission is immediately aborted. However, the problem associated with this approach is that the busy/idle bit does not distinguish between a collision state and a real idle state. Without such information, the mobile station cannot make more efficient decisions on when to start or abort a transmission.

Many of the multiple access protocols have a slotted variation. In a slotted protocol, the channel is divided into fixed size time slots. In the slotted ALOHA protocol, each slot is long enough to include a fixed size message. A variation of the slotted ALOHA called Reservation ALOHA allows a message of multiple slots (words) in length to be transmitted without interruption once the first word of the message is successfully transmitted. In Reservation ALOHA, if a station has successfully transmitted in a predetermined time slot, all the subsequent slots are implicitly reserved for that station until the station stops transmission. The problem with this scheme is that it expends one idle slot to indicate the channel's relinquishment. IEEE Transactions on Vehicular Technology, Vol.38, No. 2, May 1989, New York, US, pages 50-54; MURASE et al: "Idle-Signal Casting Multiple Access with Data Slot Reservation (ICMA-DR) for Pocket Radio Communications Device described a system that works on this basis. Such use of channel resources is inefficient.

Accordingly, it is an object of the present invention to provide an access protocol which improves transmission efficiency, while reducing access delay.

According to the present invention there is provided a method for transmitting messages using a multiple access channel between a plurality of remote stations (61) on the one hand and a central station (60) on the other hand, the multiple access channel comprising a forward channel (10) for transmission of messages from the central station to the remote stations and a reverse channel (11) for transmission of messages from the remote stations to the central station, and wherein the status of the multiple access channel is identified to the remote stations by the central station, characterized in that the method comprises:

transmitting forward bursts (13) in time slots of the forward channel(10), each forward burst comprising a code (FM) indicating whether the next time slot of the reverse channel is reserved for use by a particular remote station

or open for contention by all remote stations;
transmitting reverse bursts (12) in time slots of the reverse channel (11), each reverse burst comprising a code (RM) indicating whether the transmitting remote station requires at least one further time slot of the reverse channel to complete transmission of a message to the central station,
and wherein the forward and reverse channels comprise time slots which are spaced and offset in time such that the time slots of the forward channel are interleaved (Fig.1) with the time slots of the reverse channel.

Preferably each forward burst further comprises a code (FAA) indicating whether or not a reverse burst was successfully received by the central station on the last time slot of the reverse channel.

Preferably also the code indicating whether or not a burst was successfully received by the central station comprises a remote station identifier (FAA) when a reverse burst (12) was successfully received by the central station on the last time slot of the reverse channel.

Furthermore each reverse burst (12) comprises a remote station identifier identifying the remote station which transmitted the reverse burst.

The invention also relates to a communication system according to claim 12, a central station according to claim 13, and a remote station according to claim 14.

Other aspects of the invention are recited in the claims.

Brief Description of the Drawings

Figure 1 is an illustration showing the relative timing of forward and reverse channel transmission bursts according to the access protocol of the present invention;
Figure 2a is an illustration showing a successful burst transmission without collision on the reverse channel;
Figure 2b is an illustration of a burst transmission resulting in collision of bursts from two terminals, followed by a successful retransmission;
Figure 2c is an illustration of burst transmission with one successful and unsuccessful transmission, with retransmission after random delay by the unsuccessful terminal; and
Figure 3 is an illustration of the use of the new protocol where multiple access channels are being used.

Description of the Preferred Embodiment

As indicated above, in a cellular radio environment each cell is served by a base station communicating with multiple mobile stations. The setup channel is a full duplex channel with separate frequencies in the forward (base to mobile) and reverse (mobile to base) directions. The forward setup channel is used by the base station to transmit messages to the mobiles. This channel is a broadcast channel in which all the mobile stations can receive all the messages transmitted from the base station. The reverse channel is a random contention multiple access channel, in which mobile stations may transmit messages to the base station with relatively little coordination.

In the present embodiment of the invention, a new multiple access protocol is used in the setup channel. As shown in Figure 1, both the forward channel 10 and reverse channel 11 are divided into timeslots. The forward and reverse channel time slots are arranged in such a way that after a mobile station transmits a burst 12 on reverse channel 11, an acknowledgement burst 13 from the base station will be transmitted and received by the mobile station before the mobile transmits burst 14. The time slots need not occupy the complete channel. Duration not used by the forward or reverse channel can be allocated to other services or form other pairs of time divisional multiple access channels.

For each burst of transmission in both directions, two fields are used to support the multiple access protocol. In the forward direction, these are the forward access/acknowledgement (FAA) field 15 and the forward "more" (FM) field 16. In the reverse direction, these are the reverse access/ acknowledgement (RAA) field 17 and the reverse "more" (RM) field 18.

In the reverse channel, the RAA field carries an abbreviated identifier of the mobile station. This identifier need not uniquely identify the mobile station as long as the probability of mis-identification is much less than the probability of correct identification. If the identifier in the RAA field does not uniquely identify the transmitting mobile station, the rest of the message must contain a full identifier which will uniquely identify the mobile station. Messages in either direction may be of one or more bursts (words). The RM is a binary field which is set to Open if the current message is not continued on the next burst, otherwise the RM is set to Reserved.

In the forward direction, the FAA field is used to reflect the result of access in the last received slot in the reverse channel. If the last received slot in the reverse channel contained a successful transmission burst, the FAA will provide an acknowledgement code which is the same as the content of the RAA field of the last slot received by the base station. If the last reverse channel slot received is idle, the FAA will contain a distinct idle code which is different from all possible abbreviated identities of mobiles. If multiple mobile stations transmitted in the last reverse channel slot

resulting in mutual destruction of the collided messages, a distinct Collision code which is different from all possible abbreviated mobile identities will be transmitted.

The FM field holds a binary value representing either an Open or Reserved state. The value or state representing Open indicates the next reverse channel slot is available for contention access. The value representing Reserved indicates the next reverse channel slot is reserved for the mobile station whose abbreviated identifier is transmitted in the FAA field of the current forward burst. The base station will set the FAA and FM Fields according to the result of the last reversed slot, as follows:

Last Reverse Access Channel Slot Status	RM	FM	FAA
Idle	n/a	Open	Idle Code
Single Successful	Open	Open	Abbr.identifier
Transmission	Reserved	Reserved	Abbr.identifier
Multiple	Open	Open	Abbr.identifier
Transmission with one success	Reserved	Reserved	Abbr.identifier
Multiple Transmission without success	X	Open	Collision Code
Transmission by radio channel errors	X	Open	Collision Code

n/a indicates not applicable,
X indicates don't care.

A mobile station with a message to send to the base station will use the following algorithm to determine when to transmit:

1) Wait until the FM field indicates the next slot is open for contention.
2) Transmit the first word of the message in the next reverse slot with RAA set to the mobile station's abbreviated identifier.
3) in the next forward burst check if the FAA field is equal to the mobile station's abbreviated identifier,
    if true
        continue to transmit the current message in the consecutive reverse slots.
    if false
        abort the transmission of the rest of the message and wait a random period according to some retransmission algorithm.
        go to step 1 and try again.

As an example of implementation, the FAA can be assigned a 7-bit field which can hold an arbitrary value ranging from 0 to 127 (decimal). The abbreviated identifier uses the last two digits of the telephone number of a mobile station. The valid abbreviated identifier therefore can range between 00 (decimal) to 99 (decimal). The idle and Collision codes for the FAA field must be set to numbers that are greater than 99, since numbers 00 to 99 are reserved for abbreviated identifiers. In this embodiment, an idle code field number of 120 (decimal) and a collision code field number of 127 (decimal) is used. It will be understood by those knowledgeable in this art that the above idle and collision codes are arbitrary and may be assigned differently.

The RAA field can have the same length as the FAA with a valid abbreviated identifier range of 0 to 99 decimal. Both the RM and FM can be assigned a one bit field with 0 indicating Open and 1 indicating Reserved.

Figure 2(a) shows a successful transmission of bursts without collisions. In the forward channel 20, bursts 21 and 22 are transmitted and received to and by mobile stations A, B and C. Mobile A sends a burst 23 to the base station. It contains an abbreviated identifier RAA = 72 i.e. the mobile's last two telephone number digits and a reverse field RM = 0 indicating only one burst is sent. In the acknowledgment burst 24 sent by the base station, on the forward channel, the FAA field indicates that transmission was received since station's A abbreviated identifier is transmitted. The FM field is set to 0 indicating to all mobiles that the next reverse channel slot is available for contention access since only one burst was to be sent by station A. Upon receiving burst 24 from the forward channel, mobile station B identifies that the reverse channel is available and sends a burst 25 having a field with the identifier RAA = 37 and RM = 1. A field with RM = 1 indicates that at least one additional burst will be transmitted. The next burst 26 sent on the forward

channel 20 by the base station includes an acknowledgment field identifier FAA = 37 and a reserved field FM = 1 indicating to all mobiles that the next burst is reserved for the mobile with ID 37. Upon receiving burst 26, mobile station B identifies that the previous burst was successfully received by the base station and sends burst 27, again including the identifier RAA = 37 and reserved field RM = 1. The base station responds again in the forward channel with a similar burst 28. Mobile station B sends its last burst 29 for that message. The burst includes the same identifier field RAA = 37 but includes a field RM = 0 indicating that again the next reverse channel slot will be available for contention access. The base station responds with a burst 30 indicating to all mobiles that the next reverse channel slot is now available for contention access. If no mobile station sends a burst, the next two bursts 31 and 32 from the base station indicate the status of the channel as being idle.

Figure 2(b) shows a burst transmission scenario in which a collision destroys messages from mobile station B and C. A subsequent successful retransmission of the messages is also shown. Upon receiving burst 40 from the base station indicating that the channel is idle, station B sends burst 41 and station C sends burst 42. Since both are sent simultaneously, a collision occurs resulting in destruction of the bursts. At the base station, a status burst 43 indicating that a collision has occurred is transmitted. Upon receipt of burst 43, transmission from both mobiles is terminated. After a randomly selected delay, both mobile stations will try a retransmission of a burst. In the example of Figure 2 (b), mobile station C is the first to retransmit its burst after identifying that the channel is IDLE again. In this example, a one-word message is sent by station C. Again after a random delay, mobile B sends its message, which consist of a two-word message, i.e. bursts 44 and 45.

Figure 2 (c) shows a burst transmission in which a prospective collision event results in the successful transmission of one message to the base station but the loss of the other burst. This is reflected in the next burst transmitted by the base station with the FAA code set to the abbreviated identifier of the successful mobile station (i.e. station A). The above scenario can occur even though both messages where sent at the same time. This is possible if the burst of one station is of much greater relative power than that of the other station. The burst from the station having lower power will be discarded as noise by the base station.

In figure 2 (C), station A transmits burst 50 and station B transmits burst 51. Since the base station's acknowledgement burst includes identifier 72, station A identifies a successful transmission. However, station B identifies an unsuccessful transmission and therefore terminates the transmission of its second burst. After a random delay, mobile station B will retransmit its message, i.e. bursts 52 and 53.

Figure 3 illustrate a number of systems which can make use of the protocol defined herein. For example, the protocol of the present invention could be used in a cellular communication system, in the "setup" channel between a base station 60 and a mobile station 61. Similarly, it could be used in the communication access channel of trunk line 62 between base station 60 and an MTX switch 63. Also, between MTX switch 63 and a central office 64 or between the central office 64 and a satellite ground station 65. As with the cellular communication system, the protocol can be used in a wireless communication access channel between the ground base station 65 and a satellite 66. The protocol of the present invention is thus not limited to either wire or wireless based communication access channels.

Claims

1. A method for transmitting messages using a multiple access channel between a plurality of remote stations (61) on the one hand and a central station (60) on the other hand, the multiple access channel comprising a forward channel (10) for transmission of messages from the central station to the remote stations and a random contention multiple access reverse channel (11) for transmission of messages from the remote stations to the central station, and wherein the status (busy/idle) of the multiple access channel is identified to the remote stations by the central station, characterized in that the method comprises:

   transmitting forward bursts (13) in time slots of the forward channel(10), each forward burst comprising a code (FM) indicating whether the next time slot of the reverse channel is reserved for use by a particular remote station or open for contention by all remote stations;
   transmitting reverse bursts (12) in time slots of the reverse channel (11), each reverse burst comprising a code (RM) indicating whether the transmitting remote station requires at least one further time slot of the reverse channel to complete transmission of a message to the central station,
   and wherein the forward and reverse channels comprise time slots which are spaced and offset in time such that the time slots of the forward channel are interleaved with the time slots of the reverse channel.

2. A method as defined in claim 1, characterized in that each forward burst further comprises a code (FAA) indicating whether or not a reverse burst was successfully received by the central station on the last time slot of the reverse channel.

3. A method as defined in claim 2, characterized in that the code indicating whether or not a burst was successfully received by the central station comprises a remote station identifier (FAA) when a reverse burst was successfully received by the central station on the last time slot of the reverse channel.

4. A method as defined in claim 1, 2 or 3, characterized in that each reverse burst (12) comprises a remote station identifier (RAA) identifying the remote station which transmitted the reverse burst.

5. A method as defined in claim 2, characterized in that the code (FAA) indicating whether or not a reverse burst (12) was successfully received by the central station (60) comprises a first code (FM, FAA) when no reverse burst was received by the central station (60) on the last time slot of the reverse channel and a second code (FM, FAA) distinct from the first code when at least two reverse bursts were received by the central station on the last time slot of the reverse channel and said at least two reverse bursts interfered such that neither reverse burst could be successfully received by the central station.

6. A method as defined in claim 1, characterized in that: the central station (60) responds to receipt of a code (RM) indicating that a remote station (61) requires at least one further time slot of the reverse channel to complete transmission of a message to the central station by transmitting a code (FM, FAA) indicating that the next time slot of the reverse channel is reserved for use by the remote station;

the central station responds to receipt of a code indicating that a remote station does not require at least one further time slot of the reverse channel to complete transmission of a message to the central station by transmitting a code (FM, FAA) indicating that the next time slot of the reverse channel is open for contention by all remote stations; and
the central station responds to receipt of no reverse burst by transmitting a code (FM, FAA) indicating that the next time slot of the reverse channel is open for contention by all remote stations.

7. A method as defined in claim 6, characterized in that the remote stations (61) begin to send messages on the reverse channel only upon receipt of a code (FM, FAA) indicating that the next time slot of the reverse channel is open for contention by all remote stations.

8. A method as defined in claim 7, characterized in that a remote station (61) having sent a first burst of a multi-burst message on the reverse channel continues to send further bursts of the message on the reverse channel only if it receives a code (FM, FAA) indicating that a previous burst was successfully received by the central station (60).

9. A method as defined in claim 8, characterized in that the remote station (61) continues to send further bursts of the message on the reverse channel only if the code (FAA) indicating that the previous burst was successfully received identifies the remote station.

10. A method as defined in claim 4, characterized in that the central station (60) responds to receipt of a code (FM, FAA) identifying a transmitting remote station and a code indicating that the remote station requires at least one further time slot of the reverse channel to complete transmission of a message to the central station by transmitting a code (RM) indicating that the next time slot of the reverse channel is reserved for use by the remote station and by transmitting a code (RAA) indicating the identity of the remote station.

11. A method as defined in claim 5, characterized in that remote stations (61) having messages to transmit to the central station (60) respond to receipt of the code (FM) indicating that the reverse channel is open for contention together with the first code (FAA) indicating that no reverse burst was received by the central station on the last time slot of the reverse channel by sending a reverse burst (12) on the next time slot of the reverse channel; and
remote stations having messages to transmit to the central station respond to receipt of the code (FM) indicating that the reverse channel (11) is open for contention together with the second code (FAA = collision code) indicating that at least two reverse bursts were received by the central station on the last time slot of the reverse channel by waiting a pseudo-random number of time slots before sending a reverse burst (12) on the reverse channel (11).

12. A communication system comprising a central station (60), a plurality of remote stations (61) and a multiple access channel between the remote stations on the one hand and the central station on the other hand, the multiple access channel comprising a forward channel. (10) for transmission of messages from the central station to the remote stations and a random contention multiple access reverse channel (11) for transmission of messages from the

remote stations to the central station, and wherein the status (busy/idle) of the multiple access channel is identified to the remote stations by the central station, characterized in that:

the central station is operable to transmit forward bursts (13) in time slots of the forward channel, each forward burst comprising a code (FM) indicating whether the next time slot of the reverse channel is reserved for use by a particular remote station or open for contention by all remote stations; and

the remote stations are operable to transmit reverse bursts (12) in time slots of the reverse channel, the time slots of the reverse channel being spaced and offset in time from the time slots of the forward channel such that the time slots of the reverse channel are interleaved with the time slots of the forward channel, each reverse burst comprising a code (RM) indicating whether the transmitting remote station requires at least one further time slot of the reverse channel to complete transmission of a message to the central station.

13. A central station (60) for a communication system comprising the central station, a plurality of remote stations (61) and a multiple access channel between the remote stations on the one hand and the central station on the other hand, the multiple access channel comprising a forward channel (10) for transmission of messages from the central station to the remote stations and a random contention multiple access reverse channel (11) for transmission of messages from the remote stations to the central station, and wherein the status (busy/idle) of the multiple access channel is identified to the remote stations by the central station, characterized in that:

the central station is operable to transmit forward bursts (13) in time slots of the forward channel, each forward burst comprising a code (FM) indicating whether the next time slot of the reverse channel is reserved for use by a particular remote station or open for contention by all remote stations.

14. A remote station (61) for a communication system comprising a central station (60), a plurality of remote stations (61) and a multiple access channel between the remote stations on the one hand and the central station on the other hand, the multiple access channel comprising a forward channel (10) for transmission of messages from the central station to the remote stations and a random contention multiple access reverse channel (11) for transmission of messages from the remote stations to the central station, and wherein the status (busy/idle) of the multiple access channel is identified to the remote stations by the central station, characterized in that:

the remote station is operable to transmit reverse bursts (12) in time slots of the reverse channel, the time slots of the reverse channel being spaced and offset in time from the time slots of the forward channel such that the time slots of the reverse channel are interleaved with the time slots of the forward channel, each reverse burst comprising a code (RM) indicating whether the transmitting remote station requires at least one further time slot of the reverse channel to complete transmission of a message to the central station.

Patentansprüche

1. Verfahren zur Aussendung von Nachrichten unter Verwendung eines Vielfachzugriffskanals zwischen einer Vielzahl von entfernt angeordneten Stationen (61) einerseits und einer Zentralstation (60) andererseits, wobei der Vielfachzugriffskanal einen Vorwärtskanal (10) zur Aussendung von Nachrichten von der Zentralstation zu den entfernt angeordneten Stationen und einen mit zufälligen Konkurrenzbetrieb arbeitenden Vielfachzugriffs-Rückwärtskanal (11) für die Aussendung von Nachrichten von den entfernt angeordneten Stationen zu der Zentralstation umfaßt, und wobei der Status (Belegt/Unbelegt) des Vielfachzugriffskanals den entfernt angeordneten Stationen durch die Zentralstation identifiziert wird,
dadurch gekennzeichnet, daß das Verfahren folgende Schritte umfaßt:

Aussendung von Vorwärts-Datenblöcken (13) in Zeitschlitzen des Vorwärtskanals (10), wobei jeder Vorwärts-Datenblock einen Code (FM) umfaßt, der anzeigt, ob der nächste Zeitschlitz des Rückwärtskanals zur Verwendung durch eine bestimmte entfernt angeordnete Station reserviert oder für einen Konkurrenzbetrieb aller entfernt angeordneter Stationen frei ist,

Aussendung von Rückwärts-Datenblöcken (12) in Zeitschlitzen des Rückwärtskanals (11), wobei jeder Rückwärts-Datenblock einen Code (RM) umfaßt, der anzeigt, ob die sendende entfernt angeordnete Station zumindest einen weiteren Zeitschlitz des Rückwärtskanals benötigt, um die Aussendung einer Nachricht an die Zentralstation abzuschließen,

und wobei die Vorwärts- und Rückwärtskanäle Zeitschlitze umfassen, die mit zeitlichem Abstand angeordnet zeitlich versetzt sind, derart daß die Zeitschlitze des Vorwärtskanals mit den Zeitschlitzen des Rückwärtskanals verschachtelt sind.

2. Verfahren nach Anspruch 1,

dadurch gekennzeichnet, daß jeder Vorwärts-Datenblock weiterhin einen Code (FAA) umfaßt, der anzeigt, ob ein Rückwärts-Datenblock von der Zentralstation auf dem letzten Zeitschlitz des Rückwärtskanals erfolgreich empfangen wurde oder nicht.

3. Verfahren nach Anspruch 2,
dadurch gekennzeichnet, daß der Code, der anzeigt, ob ein Datenblock von der Zentralstation erfolgreich empfangen wurde oder nicht, eine die entfernte Station identifizierende Identifikation (FAA) umfaßt, wenn ein Rückwärts-Datenblock von der Zentralstation auf dem letzten Zeitschlitz des Rückwärtskanals erfolgreich empfangen wurde.

4. Verfahren nach Anspruch 1, 2 oder 3,
dadurch gekennzeichnet, daß jeder Rückwärts-Datenblock (12) eine eine entfernt angeordnete Station identifizierende Identifikation (RAA) umfaßt, die die entfernt angeordnete Station identifiziert, die den Rückwärts-Datenblock ausgesandt hat.

5. Verfahren nach Anspruch 2,
dadurch gekennzeichnet, daß der Code (FAA), der anzeigt, ob ein Rückwärts-Datenblock (12) von der Zentralstation (60) erfolgreich empfangen wurde oder nicht, einen ersten Code (FM, FAA) umfaßt, wenn kein Rückwärts-Datenblock von der Zentralstation (60) auf dem letzten Zeitschlitz des Rückwärtskanals empfangen wurde, während er einen zweiten, von dem ersten Code verschiedenen Code (FM, FAA) umfaßt, wenn zumindest zwei Rückwärts-Datenblöcke von der Zentralstation auf dem letzten Zeitschlitz des Rückwärtskanals empfangen wurden und die genannten zumindest zwei Rückwärts-Datenblöcke einander derart störten, daß keiner der Rückwärts-Datenblöcke von der Zentralstation erfolgreich empfangen werden konnte.

6. Verfahren nach Anspruch 1,
dadurch gekennzeichnet, daß die Zentralstation (60) auf den Empfang eines Codes (RM), der anzeigt, daß eine entfernt angeordnete Station (61) zumindest einen weiteren Zeitschlitz des Rückwärtskanals benötigt, um die Aussendung einer Nachricht an die Zentralstation abzuschließen, dadurch anspricht, daß sie einen Code (FM, FAA) aussendet, der anzeigt, daß der nächste Zeitschlitz des Rückwärtskanals für die Verwendung durch die entfernt angeordnete Station reserviert ist;

daß die Zentralstation auf den Empfang eines Codes, der anzeigt, daß die entfernt angeordnete Station nicht zumindest einen weiteren Zeitschlitz des Rückwärtskanals zum Abschluß der Aussendung einer Nachricht an die Zentralstation benötigt, durch Aussenden eines Codes (FM, FAA) anspricht, der anzeigt, daß der nächste Zeitschlitz des Rückwärtskanals für einen Konkurrenzbetrieb aller entfernt angeordneter Stationen frei ist, und die Zentralstation auf den Empfang keines Rückwärts-Datenblocks dadurch anspricht, daß sie einen Code (FM, FAA) aussendet, der anzeigt, daß der nächste Zeitschlitz des Rückwärtskanals für einen Konkurrenzbetrieb aller entfernt angeordneter Stationen frei ist.

7. Verfahren nach Anspruch 6,
dadurch gekennzeichnet, daß die entfernt angeordneten Stationen (61) mit der Aussendung von Nachrichten auf dem Rückwärtskanal lediglich bei Empfang eines Codes (FM, FAA) beginnen, der anzeigt, daß der nächste Zeitschlitz des Rückwärtskanals für einen Konkurrenzbetrieb aller entfernt angeordneter Stationen frei ist.

8. Verfahren nach Anspruch 7,
dadurch gekennzeichnet, daß eine entfernt angeordnete Station (61), die einen ersten Datenblock einer mehrere Datenblöcke umfassenden Nachricht auf dem Rückwärtskanal ausgesandt hat, weitere Datenblöcke der Nachricht auf den Rückwärtskanal nur dann aussendet, wenn sie einen Code (FM, FAA) empfängt, der anzeigt, daß ein vorhergehender Datenblock erfolgreich von der Zentralstation (60) empfangen wurde.

9. Verfahren nach Anspruch 8,
dadurch gekennzeichnet, daß die entfernt angeordnete Station (61) weitere Datenblöcke der Nachricht auf dem Rückwärtskanal nur dann weiter aussendet, wenn der Code (FAA), der anzeigt, daß der vorhergehende Datenblock erfolgreich empfangen wurde, die entfernt angeordnete Station identifiziert.

10. Verfahren nach Anspruch 4,
dadurch gekennzeichnet, daß die Zentralstation (60) auf den Empfang eines Codes (FM, FAA), der eine sendende entfernt angeordnete Station identifiziert und eines Codes, der anzeigt, daß die entfernt angeordnete Station zu-

mindest einen weiteren Zeitschlitz des Rückwärtskanals benötigt, um die Aussendung einer Nachricht an die Zentralstation abzuschließen, dadurch anspricht, daß sie einen Code (RM) aussendet, der anzeigt, daß der nächste Zeitschlitz des Rückwärtskanals zur Verwendung durch die entfernt angeordnete Station reserviert ist, und daß sie einen Code (RAA) aussendet, der die Identität der entfernt angeordneten Station anzeigt.

11. Verfahren nach Anspruch 5,
dadurch gekennzeichnet, daß entfernt angeordnete Stationen (61), die an die Zentralstation (60) auszusendende Nachrichten haben, auf den Empfang des Codes (FM), der anzeigt, daß der Rückwärtskanal für einen Konkurrenzbetrieb offen ist, zusammen mit dem ersten Code (FAA), der anzeigt, daß kein Rückwärts-Datenblock von der Zentralstation auf dem letzten Zeitschlitz des Rückwärtskanals empfangen wurde, dadurch ansprechen, daß sie einen Rückwärts-Datenblock (12) auf dem nächsten Zeitschlitz des Rückwärtskanals aussenden, und daß
entfernt angeordnete Stationen, die an die Zentralstation auszusendende Nachrichten haben, auf den Empfang des Codes (FM), der anzeigt, daß der Rückwärtskanal (11) für einen Konkurrenzbetrieb frei ist, zusammen mit dem zweiten Code (FAA = Kollisions-Code), der anzeigt, daß zumindest zwei Rückwärts-Datenblöcke von der Zentralstation auf dem letzten Zeitschlitz des Rückwärtskanals empfangen wurden, dadurch ansprechen, daß sie eine pseudo-zufällige Anzahl von Zeitschlitzen warten, bevor sie einen RückwärtsDatenblock (12) auf den Rückwärtskanal (11) aussenden.

12. Kommunikationssystem mit einer Zentralstation (60), einer Vielzahl von entfernt angeordneten Stationen (61) und einem Vielfachzugriffskanal zwischen den entfernt angeordneten Stationen einerseits und der Zentralstation andererseits, wobei der Vielfachzugriffskanal einen Vorwärtskanal (10) zur Aussendung von Nachrichten von der Zentralstation an die entfernt angeordneten Stationen und einen mit zufälligem Konkurrenzbetrieb arbeitenden Vielfachzugriffs-Rückwärtskanal (11) zur Übertragung von Nachrichten von den entfernt angeordneten Stationen zu der Zentralstation umfaßt, und wobei der Status (Belegt/Unbelegt) des Mehrfachzugriffskanals den entfernt angeordneten Stationen durch die Zentralstation identifiziert wird,
dadurch gekennzeichnet, daß:

die Zentralstation betreibbar ist, um Vorwärts-Datenblöcke (13) in Zeitschlitzen des Vorwärtskanals zu senden, wobei jeder Vorwärts-Datenblock einen Code (FM) umfaßt, der anzeigt, ob der nächste Zeitschlitz des Rückwärtskanals für die Verwendung durch eine bestimmte entfernt angeordnete Station reserviert oder für den Konkurrenzbetrieb aller entfernt angeordneter Stationen frei ist, und
die entfernt angeordneten Stationen zur Aussendung von Rückwärts-Datenblöcken (12) in Zeitschlitzen des Rückwärtskanals betreibbar sind, wobei die Zeitschlitze des Rückwärtskanals zeitlich mit Abstand voneinander und zeitlich versetzt gegenüber den Zeitschlitzen des Vorwärtskanals derart angeordnet sind, daß die Zeitschlitze des Rückwärtskanals mit den Zeitschlitzen des Vorwärtskanals verschachtelt sind, wobei jeder Rückwärts-Datenblock einen Code (RM) umfaßt, der anzeigt, ob die sendende entfernt angeordnete Station zumindest einen weiteren Zeitschlitz des Rückwärtskanals benötigt, um die Aussendung einer Nachricht an die Zentralstation abzuschließen.

13. Zentralstation (60) für ein Kommunikationssystem, das die Zentralstation, eine Vielzahl von entfernt angeordneten Stationen (61) und einen Vielfachzugriffskanal zwischen den entfernt angeordneten Stationen einerseits und der Zentralstation andererseits umfaßt, wobei der Vielfachzugriffskanal einen Vorwärtskanal (10) zur Aussendung von Nachrichten von der Zentralstation an die entfernt angeordneten Stationen und einen mit zufälligem Konkurrenzbetrieb arbeitenden Vielfachzugriffs-Rückwärtskanal (11) zur Aussendung von Nachrichten von den entfernt angeordneten Stationen zu der Zentralstation umfaßt, und wobei der Status (Belegt/Unbelegt) des Vielfachzugriffskanals den entfernt angeordneten Stationen durch die Zentralstation identifiziert wird,
dadurch gekennzeichnet, daß:
die Zentralstation zur Aussendung von Vorwärts-Datenblöcken (13) in Zeitschlitzen des Vorwärtskanals betreibbar ist, wobei jeder Vorwärts-Datenblock einen Code (FM) umfaßt, der anzeigt, ob der nächste Zeitschlitz des Rückwärtskanals zur Verwendung durch eine bestimmte entfernt angeordnete Station reserviert oder für einen Konkurrenzbetrieb aller entfernt angeordneter Stationen frei ist.

14. Entfernt angeordnete Station (61) für ein Kommunikationssystem, das eine Zentralstation (60), eine Vielzahl von entfernt angeordneten Stationen (61) und einen Vielfachzugriffskanal zwischen den entfernt angeordneten Stationen einerseits und der Zentralstation andererseits umfaßt, wobei der Vielfachzugriffskanal einen Vorwärtskanal (10) zur Aussendung von Nachrichten von der Zentralstation an die entfernt angeordneten Stationen und einen mit zufälligem Konkurrenzbetrieb arbeitenden Vielfachzugriffs-Rückwärtskanal (11) zur Aussendung von Nachrichten von den entfernt angeordneten Stationen an die Zentralstation umfaßt, und wobei der Status (Belegt/Un-

belegt) des Vielfachzugriffskanals den entfernt angeordneten Stationen von der Zentralstation identifiziert wird, dadurch gekennzeichnet, daß:

die entfernt angeordnete Station zur Aussendung von Rückwärts-Datenblöcken (12) in Zeitschlitzen des Rückwärtskanals betreibbar ist, wobei die Zeitschlitze des Rückwärtskanals zeitlich mit Abstand voneinander angeordnet und zeitlich gegenüber den Zeitschlitzen des Vorwärtskanals derart versetzt sind, daß die Zeitschlitze des Rückwärtskanals mit den Zeitschlitzen des Vorwärtskanals verschachtelt sind, wobei jeder Rückwärts-Datenblock einen Code (RM) umfaßt, der anzeigt, ob die sendende entfernt angeordnete Station zumindest einen weiteren Zeitschlitz des Rückwärtskanals benötigt, um die Aussendung einer Nachricht an die Zentralstation abzuschließen.

Revendications

1. Procédé d'émission de messages à l'aide d'un canal à accès multiple entre plusieurs stations distantes (61) d'une part et une station centrale (60) d'autre part, le canal à accès multiple comprenant un canal direct (10) pour l'émission de messages de la station centrale aux stations distantes et un canal inverse (11) à accès multiple à contention aléatoire destiné à l'émission de messages des stations distantes à la station centrale, et dans lequel l'état (occupé-libre) du canal à accès multiple est identifié pour les stations distantes par la station centrale, caractérisé en ce que le procédé comprend :

   l'émission de salves directes (13) dans des tranches temporelles du canal direct (10), chaque salve directe comprenant un code (FM) qui indique si la tranche temporelle suivante du canal inverse est réservée pour être utilisée par une station distante particulière ou est libre pour la contention par toutes les stations distantes, et

   l'émission de salves inverses (12) dans les tranches temporelles du canal inverse (11), chaque salve inverse comprenant un code (RM) qui indique si la station distante émettrice demande au moins une tranche temporelle supplémentaire du canal inverse pour terminer l'émission d'un message vers la station centrale, et dans lequel les canaux direct et inverse ont des tranches temporelles qui sont espacées et décalées dans le temps de manière que les tranches temporelles du canal direct soient entrelacées avec les tranches temporelles du canal inverse.

2. Procédé selon la revendication 1, caractérisé en ce que chaque salve directe comporte en outre un code (FAA) indiquant si une salve inverse a été reçue de manière satisfaisante ou non par la station centrale à la dernière tranche temporelle du canal inverse.

3. Procédé selon la revendication 2, caractérisé-en ce que le code indiquant si une salve a été reçue de manière satisfaisante ou non par la station centrale comporte un identificateur de station distante (FAA) lorsqu'une salve inverse a été reçue de manière satisfaisante par la station centrale dans la dernière tranche temporelle du canal inverse.

4. Procédé selon la revendication 1, 2 ou 3, caractérisé en ce que chaque salve inverse (12) comporte un identificateur de station distante (RAA) qui identifie la station distante qui a émis la salve inverse.

5. Procédé selon la revendication 2, caractérisé en ce que le code (FAA) qui indique si une salve inverse (12) a été reçue de manière satisfaisante ou non par la station centrale (60) comporte un premier code (FM, FAA) lorsqu'aucune salve inverse n'a été reçue par la station centrale (60) à la dernière tranche temporelle du canal inverse, et un seconde code (FM, FAA) distinct du premier code lorsque deux salves inverses au moins ont été reçues par la station centrale dans la dernière tranche temporelle du canal inverse et les deux salves inverses au moins ont interféré si bien qu'aucune salve inverse n'a pu être reçue de manière satisfaisante par la station centrale.

6. Procédé selon la revendication 1, caractérisé en ce que :

   la station centrale (60) répond à la réception d'un code (RM) indiquant qu'une station distante (61) a besoin d'au moins une tranche temporelle supplémentaire du canal inverse pour terminer l'émission d'un message vers la station centrale par émission d'un code (FM, FAA) indiquant que la tranche temporelle suivante du canal inverse est réservée pour être utilisée par la station distante,
   la station centrale répond à la réception d'un code indiquant qu'une station distante n'a pas besoin d'au moins une tranche temporelle supplémentaire du canal inverse pour terminer l'émission d'un message vers la station

centrale par émission d'un code (FM, FAA) indiquant que la tranche temporelle suivante du canal inverse est libre pour la contention par toutes les stations distantes, et
la station centrale répond à l'absence de réception d'une salve inverse par émission d'un code (FM, FAA) qui indique que la tranche temporelle suivante du canal inverse est libre pour la contention par toutes les autres stations distantes.

7. Procédé selon la revendication 6, caractérisé en ce que les stations distantes (61) commencent à émettre les messages dans le canal inverse uniquement après réception d'un code (FM, FAA) indiquant que la tranche temporelle suivante du canal inverse est libre pour la contention par toutes les stations distantes.

8. Procédé selon la revendication 7, caractérisé en ce qu'une station distante (61) ayant émis une première salve d'un message à plusieurs salves par le canal inverse continue à émettre d'autres salves du message dans le canal inverse uniquement lorsqu'elle reçoit un code (FM, FAA) indiquant qu'une salve précédente a été reçue de manière satisfaisante par la station centrale (60).

9. Procédé selon la revendication 8, caractérisé en ce que la station distante (61) continue à émettre d'autres salves du message dans le canal inverse uniquement lorsque le code (FAA) indiquant que la salve précédente a été reçue de manière satisfaisante identifie la station distante.

10. Procédé selon la revendication 4, caractérisé en ce que la station centrale (60) répond à la réception d'un code (FM, FAA) identifiant une station distante émettrice et un code indiquant que la station distante a besoin d'au moins une tranche temporelle supplémentaire du canal inverse pour terminer l'émission d'un message vers la station centrale par émission d'un code (RM) indiquant que la tranche temporelle suivante du canal inverse est réservée pour être utilisée par la station distante et par émission d'un code (RAA) indiquant l'identité de la station distante.

11. Procédé selon la revendication 5, caractérisé en ce que des stations distantes (61) ayant des messages à émettre vers la station centrale (60) répondent à la réception du code (FM) indiquant que le canal inverse est libre pour la contention avec le premier code (FAA) indiquant qu'aucune salve inverse n'a été reçue par la station centrale dans la dernière tranche temporelle du canal inverse par émission d'une salve inverse (12) à la tranche temporelle suivante du canal inverse, et
les stations distantes ayant des messages à émettre vers la station centrale répondent à la réception du code (FM), indiquant que le canal inverse (11) est libre pour la contention, avec le second code (FAA = code de collision), indiquant que deux salves inverses au moins ont été reçues par la station centrale à la dernière tranche temporelle du canal inverse, par attente d'un nombre pseudo-aléatoire de tranches temporelles avant d'émettre une salve inverse (12) dans le canal inverse (11).

12. Système de communications comprenant une station centrale (60), plusieurs stations distantes (61) et un canal à accès multiple placé entre les stations distantes d'une part et la station centrale d'autre part, le canal à accès multiple comprenant un canal direct (10) pour l'émission de messages de la station centrale aux stations distantes et un canal inverse à accès multiple à contention aléatoire (11) pour l'émission de messages des stations distantes à la station centrale, et dans lequel l'état (occupé-libre) du canal à accès multiple est identifié pour les stations distantes par la station centrale, caractérisé en ce que :

la station centrale est destinée à émettre des salves directes (13) dans des tranches temporelles du canal direct, chaque salve directe comprenant un code (FM) indiquant si la tranche temporelle suivante du canal inverse est réservée pour être utilisée par une station distante particulière ou non ou est libre pour la contention par toutes les stations distantes, et
les stations distantes fonctionnent par émission de salves inverses (12) dans des tranches temporelles du canal inverse, les tranches temporelles du canal inverse étant espacées et décalées dans le temps par rapport aux tranches temporelles du canal direct de manière que les tranches temporelles du canal inverse soient entrelacées avec les tranches temporelles du canal direct, chaque salve inverse comprenant un code (RM) qui indique si la station distante émettrice a besoin d'au moins une tranche temporelle supplémentaire du canal inverse pour terminer l'émission d'un message vers la station centrale.

13. Station centrale (60) destinée à un système de communications qui comprend la station centrale, plusieurs stations distantes (61) et un canal à accès multiple entre les stations distantes d'une part et la station centrale d'autre part, le canal à accès multiple comprenant un canal direct (10) pour l'émission de messages de la station centrale aux stations distantes et un canal inverse à accès multiple à contention aléatoire (11) pour l'émission de messages

des stations distantes à la station centrale, et dans lequel l'état (occupé-libre) du canal à accès multiple est identifié pour les stations distantes par la station centrale, caractérisée en ce que :

la station centrale est destinée à émettre des salves directes (13) dans des tranches temporelles du canal direct, chaque salve directe comprenant un code (FM) qui indique si la tranche temporelle suivante du canal inverse est réservée pour être utilisée par une station distante particulière ou est libre pour la contention par toutes les stations distantes.

14. Station distante (61) destinée à un système de communications comprenant une station centrale (60), plusieurs stations distantes (61) et un canal à accès multiple placé entre les stations distantes d'une part et la station centrale d'autre part, le canal à accès multiple comprenant un canal direct (10) pour l'émission de messages de la station centrale aux stations distantes et un canal inverse à accès multiple à contention aléatoire (11) pour l'émission de messages des stations distantes à la station centrale, et dans lequel l'état (occupé-libre) du canal à accès multiple est identifié pour les stations distantes par la station centrale, caractérisée en ce que :

la station distante peut assurer l'émission de salves inverses (12) dans des tranches temporelles du canal inverse, les tranches temporelles du canal inverse étant espacées et décalées dans le temps par rapport aux tranches temporelles du canal direct de manière que les tranches temporelles du canal inverse soient entrelacées entre les tranches temporelles du canal direct, chaque salve inverse comprenant un code (RM) qui indique si la station distante émettrice a besoin d'au moins une tranche temporelle supplémentaire du canal inverse pour terminer l'émission d'un message vers la station centrale.

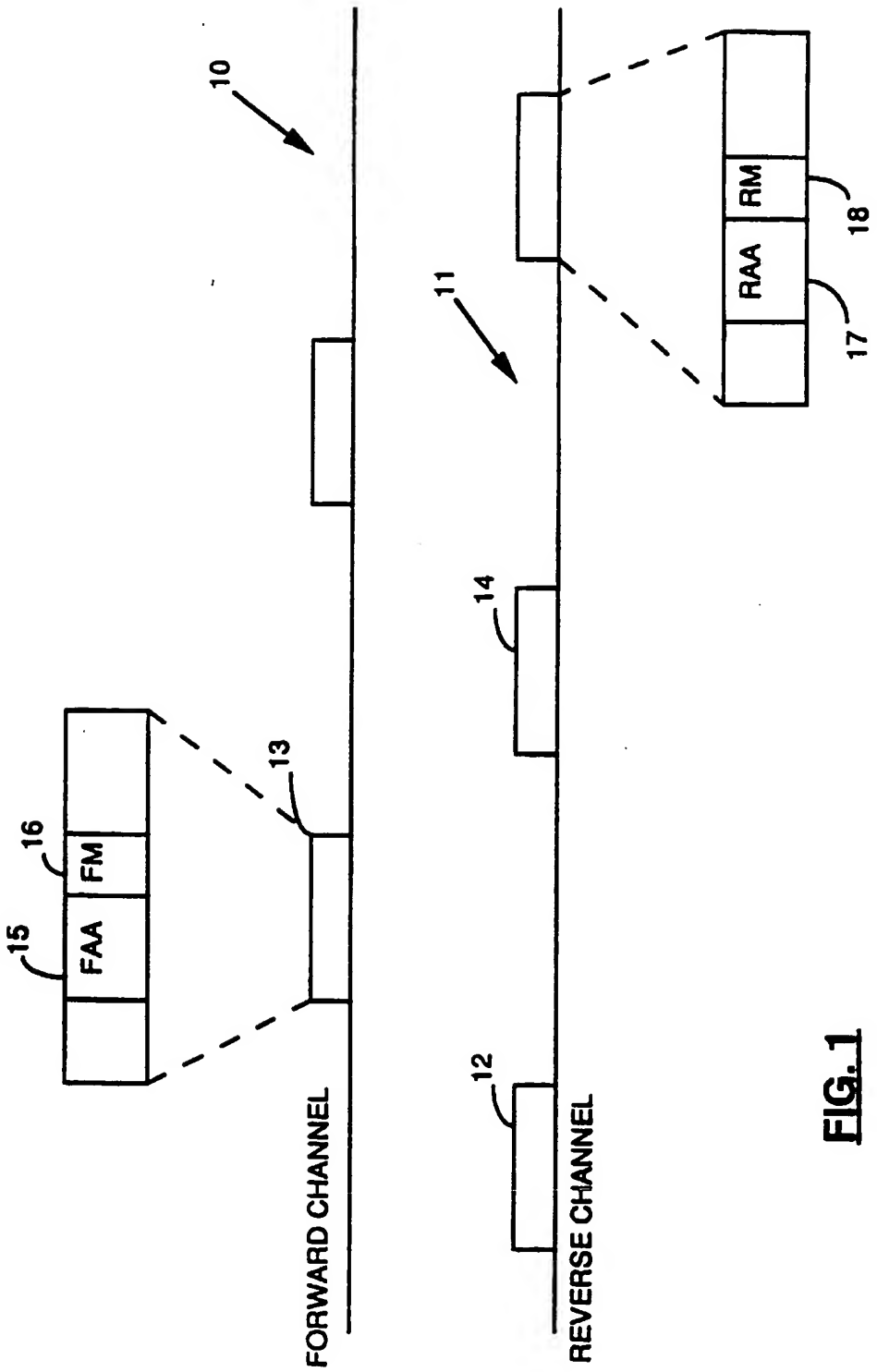
10
11
12
13
14
15
16
17
18
FAA
FM
RAA
RM
FORWARD CHANNEL
REVERSE CHANNEL

FIG. 1

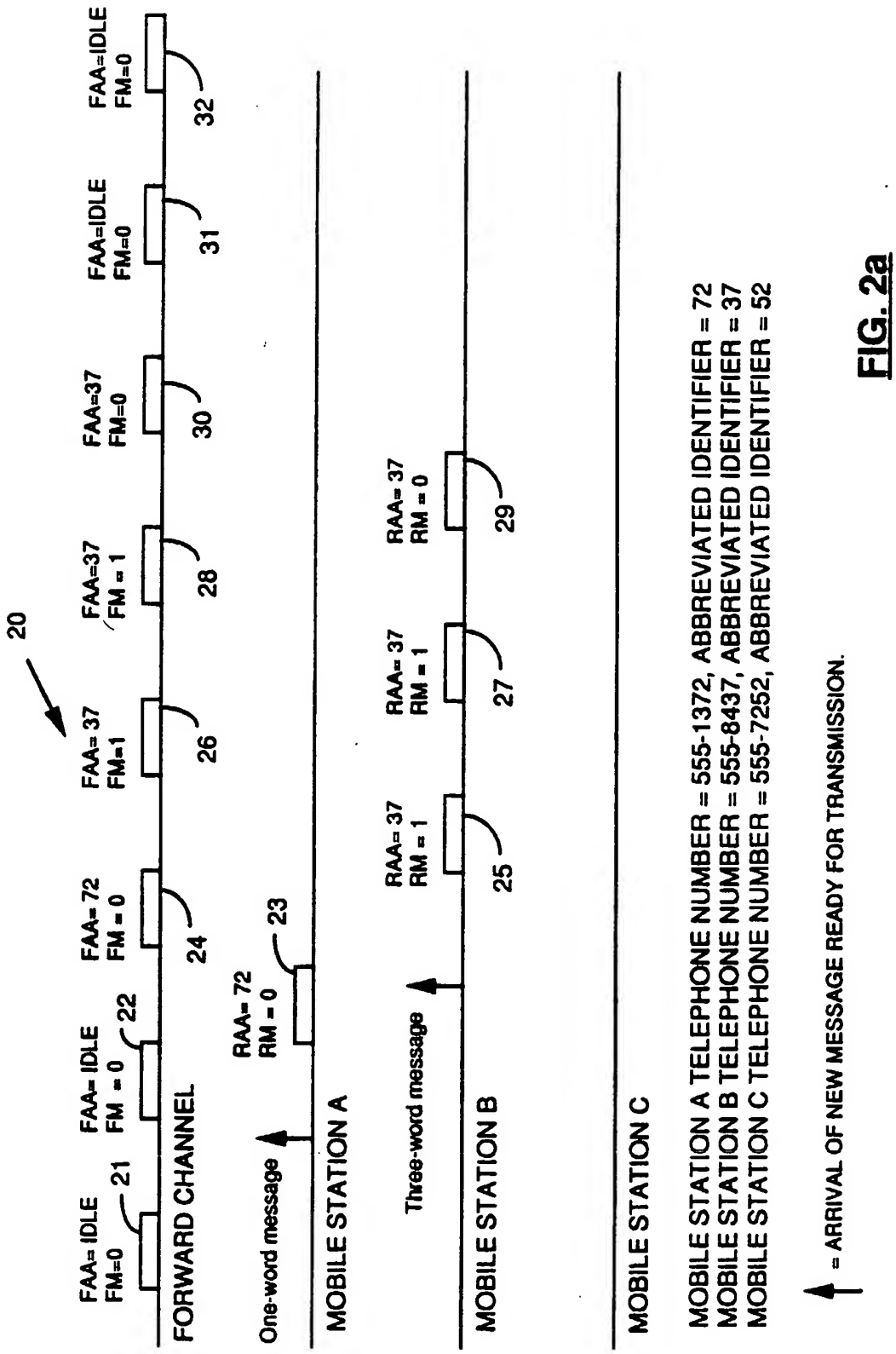
20
FAA= IDLE
FM=0
21
FAA= IDLE
FM = 0
22
FAA= 72
FM = 0
24
FAA= 37
FM=1
26
FAA=37
FM = 1
28
FAA=37
FM=0
30
FAA=IDLE
FM=0
31
FAA=IDLE
FM=0
32
FORWARD CHANNEL
One-word message
RAA= 72
RM = 0
23
MOBILE STATION A
Three-word message
RAA= 37
RM = 1
25
RAA= 37
RM = 1
27
RAA= 37
RM = 0
29
MOBILE STATION B
MOBILE STATION C
MOBILE STATION A TELEPHONE NUMBER = 555-1372, ABBREVIATED IDENTIFIER = 72
MOBILE STATION B TELEPHONE NUMBER = 555-8437, ABBREVIATED IDENTIFIER = 37
MOBILE STATION C TELEPHONE NUMBER = 555-7252, ABBREVIATED IDENTIFIER = 52
= ARRIVAL OF NEW MESSAGE READY FOR TRANSMISSION.

FIG. 2a

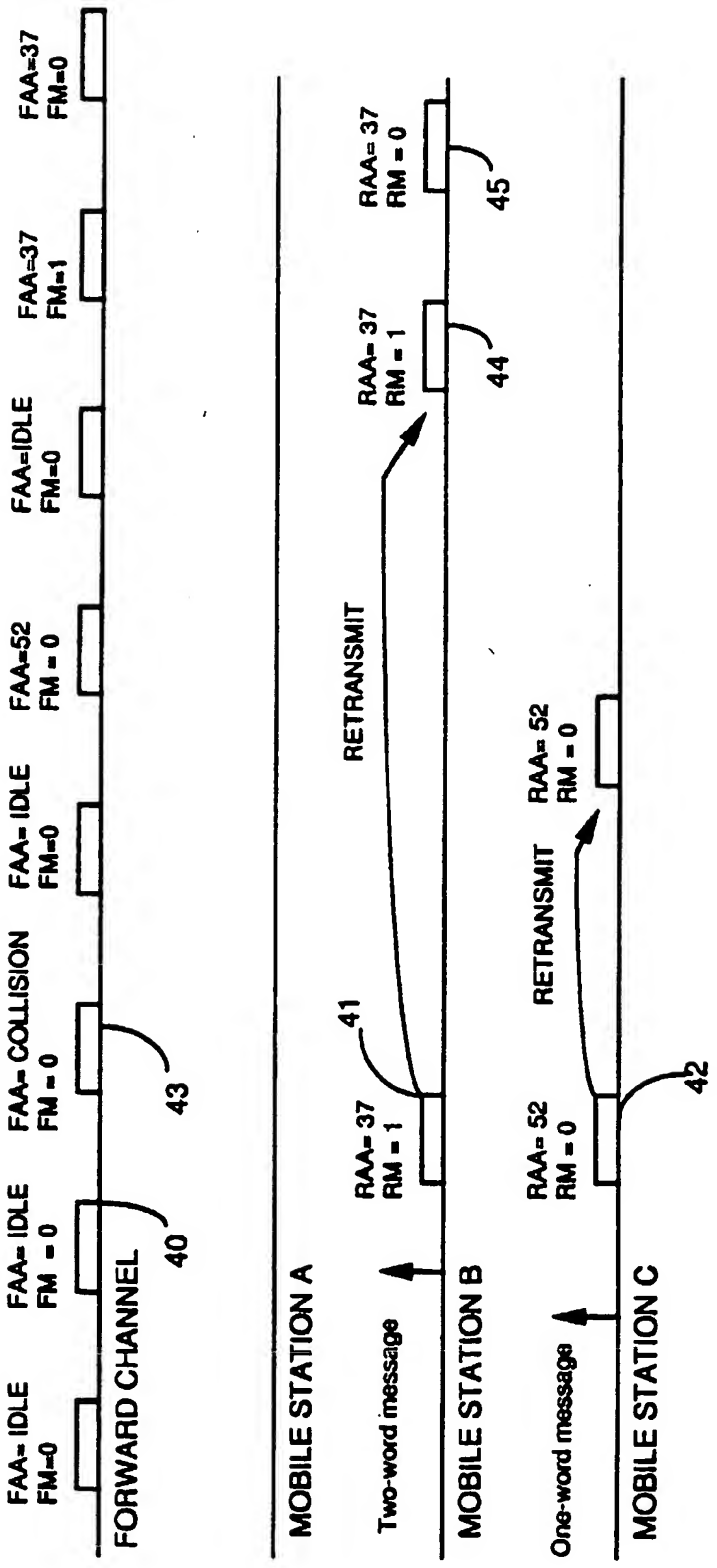
FAA= IDLE
FM=0
FAA= IDLE
FM = 0
FAA= COLLISION
FM = 0
FAA= IDLE
FM=0
FAA=52
FM = 0
FAA=IDLE
FM=0
FAA=37
FM=1
FAA=37
FM=0
FORWARD CHANNEL
40
43
MOBILE STATION A
Two-word message
RAA= 37
RM = 1
41
RETRANSMIT
RAA= 37
RM = 1
44
RAA= 37
RM = 0
45
MOBILE STATION B
One-word message
RAA= 52
RM = 0
RETRANSMIT
RAA= 52
RM = 0
42
MOBILE STATION C

FIG. 2b

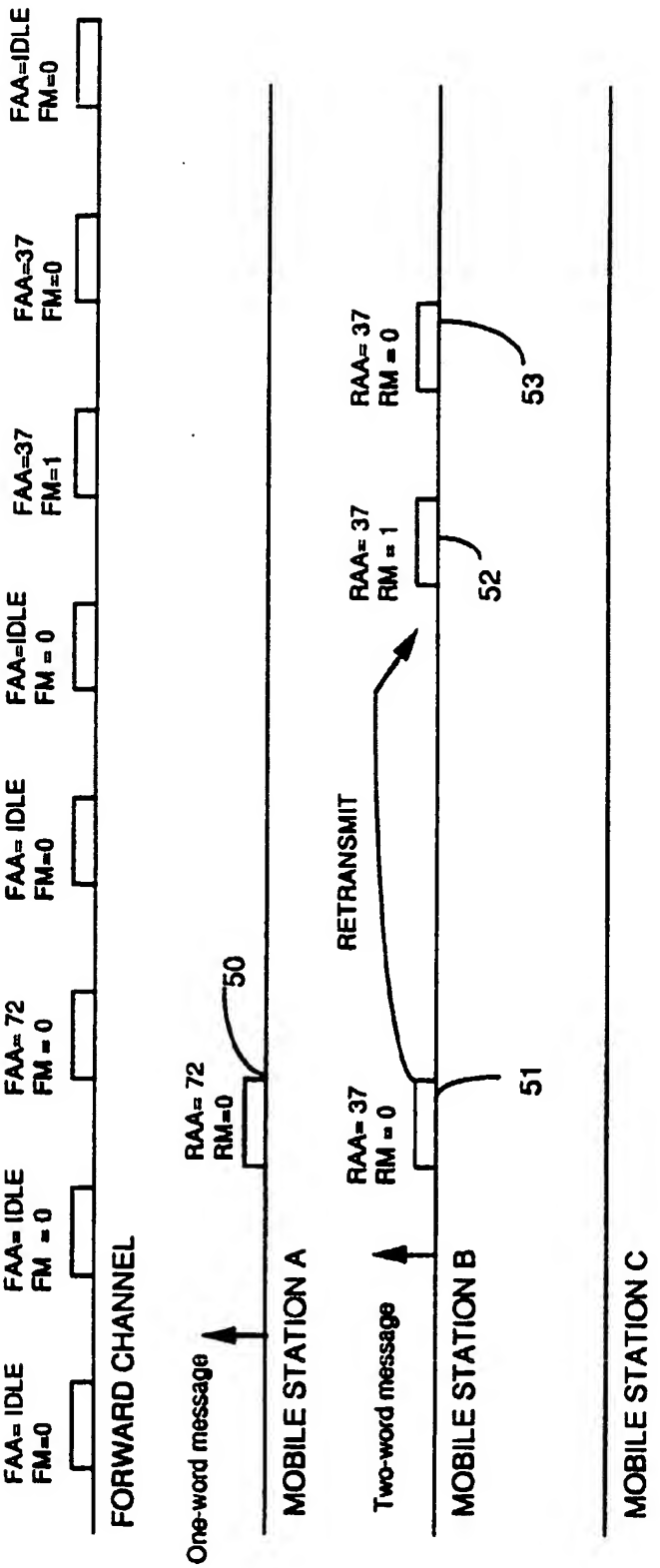
FAA= IDLE FM=0
FAA= IDLE FM = 0
FAA= 72 FM = 0
FAA= IDLE FM=0
FAA=IDLE FM = 0
FAA=37 FM=1
FAA=37 FM=0
FAA=IDLE FM=0
FORWARD CHANNEL
One-word message
RAA= 72 RM=0
50
MOBILE STATION A
RETRANSMIT
Two-word message
RAA= 37 RM = 0
RAA= 37 RM = 1
RAA= 37 RM = 0
51
52
53
MOBILE STATION B
MOBILE STATION C

FIG. 2c

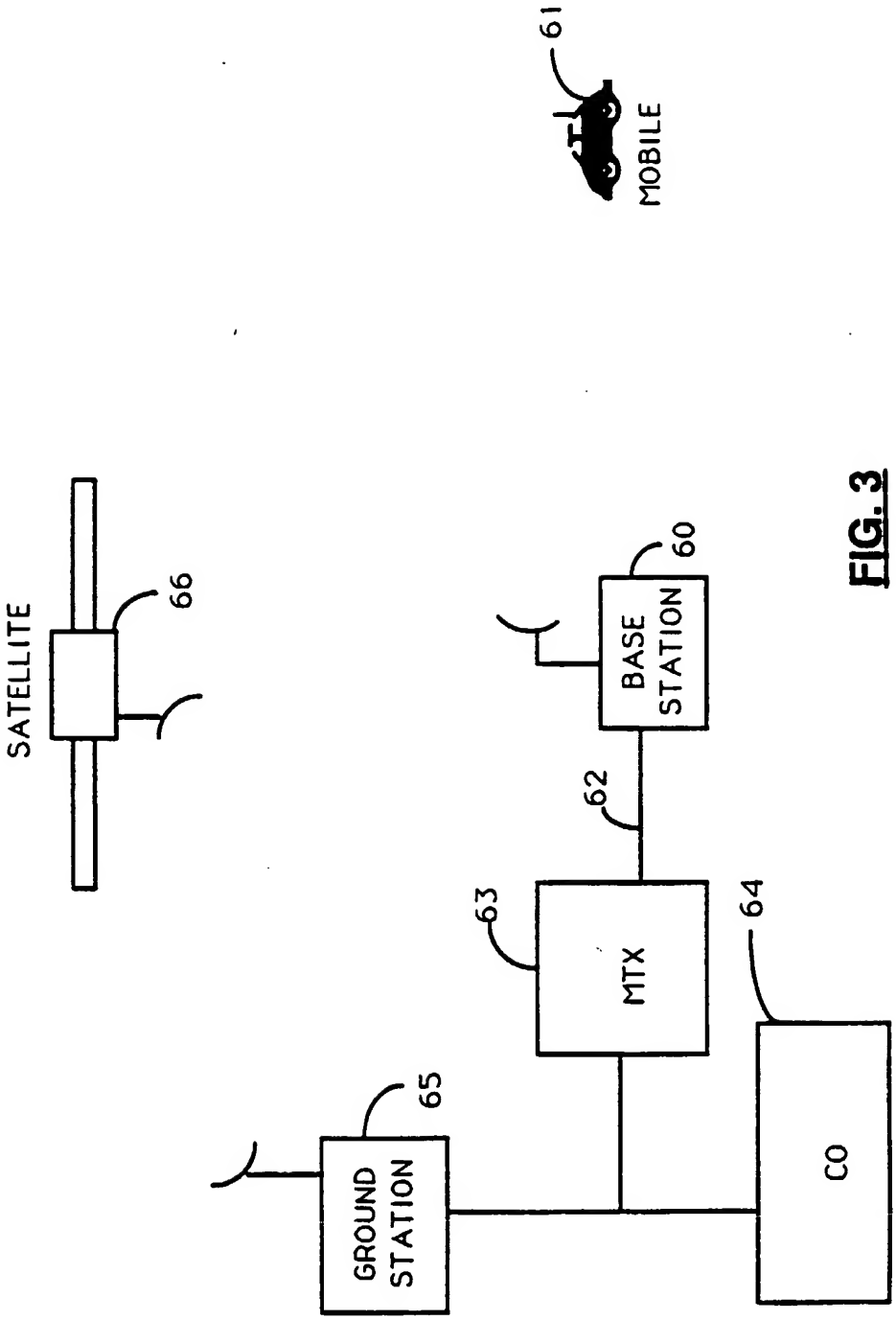
61
MOBILE
SATELLITE
66
BASE STATION
60
62
63
MTX
64
65
GROUND STATION
CO

FIG. 3